EVIDENCE OF GLACIAL DRIFT AND ERRATICS ON SOME BEDROCK KNOBS NEAR THE WISCONSIN GLACIAL BOUNDARY IN THE AMANDA QUADRANGLE, OHIO

SENIOR THESIS

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ABSTRACT

Several bedrock knobs less than a mile north of the Wisconsin glacial boundary in Fairfield County, Ohio, were mapped by previous workers as drift-free areas of resistant bedrock. Investigation of most of these knobs in the Amanda Quadrangle, Ohio, was made to determine the validity of these previous findings. With the exception of one knob, all of the knobs investigated contain glacial drift in the form of erratics and a weathered clayey soil developed on glacial till and/or loess.

PREVIOUS INVESTIGATIONS

One of the first investigations done on the glacial features of Fairfield County was done by E. B. Andrews in 1874 for the Geologic Survey of Ohio. Others that did early work in the area were T. C. Chamberlin, F. Leverett, and G. W. White (Conley, 1956). All of these men merely glimpsed at the glacial features of the county while tracing moraines or glacial boundaries through the county. The first research exclusively on the glacial geology of the area was by James Conley in 1956. This work was used in 1962 as background information for

Jane Forsyth's description of the Glacial Geology of Fairfield County which appears in Bulletin 60 of the Geological Survey of Ohio. It was the glacial map by Jane Forsyth that lead to the problem of whether or not the knobs marked drift-free were in reality drift-free. R. Petro and others made a soil survey of the county in 1951, used by Conley and Forsyth to help with their work on the soils of the area. Petro mentioned that there were drift-free knobs of bedrock in the area. He also described the glacial history of the area as it pertains to soil development.

PURPOSE OF INVESTIGATION

The purpose of investigation of these knobs is to prove that post-glacial erosion could not have removed all traces of glaciation from the flat tops of these knobs in the period of time since this part of Fairfield County was last glaciated. There must have been other factors that made the evidence of drift hard to find, other than the effects of erosion. The investigation was started on the assumption that the hills were glaciated and that there were one or more factors which contributed to the fact that evidence of glaciation was missed by three previous investigators. Although these investigators do not conc ur completely as to which knobs are drift-free, there are a few hills which all three agree on. A comparison of the findings of Petro, Conley, and Forsyth on the knobs investigated by this report appears in Table I.

TABLE I

Comparison of previous investigations by R. Petro, 1951, J. Conley, 1956, and J. Forsyth, 1962.

U- Drift-free knobs of bedrock

G- Glaciated knobs with drift present

HILL*	PETRO	CONLEY	FORSYTH
1	U	U	U
2	G	G	U
3	U	U	U
4	U	U	U
5	U	G	U
6	U	G	U
7	U	G	U
8	U	G	U
9	U	G	U
10	U	G	U
11	U	G	U
12	U	G	U
13	U	G	U
14	U	G	U
15	U	G	U
16	U	U	U
17	U	U	U
18	U	G	U
19	U	G	U

*All locations can be found on Plate I

GEOLOGY OF THE REGION

All of the bedrock knobs under investigation on the Amanda Quadrangle are underlain by the Black Hand Member of the Cuyahoga Formation of Mississippian age (Wolfe, 1962). This is a light to dark brown, poorly cemented, coarse-grained sandstone conglomerate. The dip on these beds is horizontal.

PLANNING AND PROCEDURES

Seventeen bedrock knobs were selected near the Wisconsin-Illinoian glacial boundary. These knobs were located on the Glacial Map of Fairfield County, Ohio, mapped by Forsyth (1962) and were chosen because of their proximity to the Illinoian-Unglaciated area boundary. On the Glacial Map, these knobs are marked with a "U", meaning, "...drift-free areas of bedrock, north of the glacial boundary." (Forsyth, 1962)

In the field, investigation was undertaken mainly on the crests of the knobs. Holes were dug at random, usually until bedrock was reached or until evidence of glacial deposition was found. Erratics were collected whenever possible and were analyzed as to lithology, roundness, shape, and weathering. The lithologies of these erratics include limestone, shale, quartz monzonite, schist, basalt, diorite, chert, gabbro, marble, and tillite, but were mainly gneiss, granite, and quartzite. Most of the erratics are moderately weathered and rounded, with a range in size from .5 inches to 3 feet in

diameter. The clayiness of the soils on the crests of the knobs was noted and soil profiles were sketched whenever necessary. All excavations or places where erratics were found were plotted on a map (See Plate I).

OBSERVATIONS

All locations and points referred to are on Plate I, the Amanda Quadrangle, Ohio.

HILL 1, CLAYPOOL KNOB, NW ¼, NE ¼, Sec. 10, T14N, R19W, and SW ¼, SE ¼, Sec. 3, T14N, R19W, Amanda Quadrangle

This knob is 110 feet high above the surrounding till plain, with steep sides. The crest is flat with a clayey soil much like on Allen Knob, (Figure 1).

P- Pebbles of moderately weathered, rounded gneiss and quartzite (0.5 to 1 inch in diameter) were buried 4 to 12 inches in the soil on the top of the knob.

HILL 2, SW ¼, SW ¼, Sec. 11, T14N, R19W, and NW ¼, NW ¼, Sec. 14, T14N, R19W, Amanda Quadrangle

Knob is 40 feet high above the surrounding till plain, with gently sloping sides. Soil is clayey, developed on till and/or loess, and contains many erratics.

C_1- At the crest of the knob, holes were dug 2 feet into the soil and samples of angular to subangular, moderately weathered pebbles (0.5 to 2 inches in diameter) of granite, quartz monzonite, gneiss, and quartzite were in abundance. Soil is somewhat more silty than on Allen Knob (Figure 1). Lying about on

the surface are boulders (1 to 1.5 feet in diameter) of sandstone with no apparent source.

HILLS 3, SERIES OF KNOBS SOUTH EAST OF STONEWALL CEMETERY, SW $\frac{1}{4}$, Sec. 14, T14N, R19W, Amanda Quadrangle, due south of Lancaster.

These knobs average 130 feet high above the surrounding till plain, and each has a flat top. The soil on these knobs is much like that on Allen Knob (Figure 1), but is not quite as thick, and is developed on till and/or loess.

I- Angular to subangular, moderately weathered pebbles of gneiss and granite (1 to 3 inches in diameter) were on the surface and a few inches below in the soil.

J- Rounded, moderately weathered pebbles of quartzite, limestone, and basalt (2 to 3 inches in diameter) were 0.5 to 1 foot in the soil, halfway up the slope to the top of the knob.

K_1- Holes excavated into the soil show a profile, as in Figure 4. An erratic collected is a subangular pebble (2 inches in diameter) of diorite.

K_2- Rounded to subangular pebbles (4 to 6 inches in diameter) of quartzite and limestone occurred 4 to 6 inches deep in the soil, at the crest of the knob.

L- Rounded, slightly weathered pebbles (0.5 to 1 inch in diameter) of quartzite and gneiss were buried 2 to 10 inches in the soil, near the crest of the knob.

HILL 4, BECK'S KNOB, SW ¼, SW ¼, Sec. 10, T14N, R19W, Amanda Quadrangle

Knob is 160 feet high above the surrounding till plain, with steep sides. Crest of knob is flat and has a clayey soil developed on till and/or loess. Large boulders of sandstone (up to 1.5 feet in diameter) lie randomly on the surface with no apparent source area.

B_1- Angular, moderately weathered pebbles (0.5 to 1 inch in diameter) of quartzite, gneiss, granite, shale, and limestone were located 0.5 to 2 feet deep in the soil at the crest of the knob.

HILL 5, KNOB EAST OF ALLEN KNOB, SW ¼, NW ¼, Sec. 15, T14N, R19W, Amanda Quadrangle

Knob is 110 feet high above the surrounding till plain, with steep sides. A clayey soil much like that of Allen Knob (Figure 1) is developed on till and/or loess on the top and sides of the hill. Numerous large boulders (up to 3 feet in diameter) of sandstone lie randomly on the surface with no apparent source. Crest of knob is flat.

HILL 6, ALLEN KNOB, SE ¼, NW ¼, Sec. 15, T14N, R19W, Amanda Quadrangle

Knob is 130 feet high above the surrounding till plain, with steep sides and some quarrying of sandstone done on the southwest side of the hill. The crest of the knob is unusually flat, with a clayey soil developed on

till and/or loess.

A_1- Rounded, moderately weathered pebble of granite (1 inch in diameter) on the surface.

A_2- A depression in the soil was found, approximately 25 feet by 8 feet, and 3 feet deep, which could possibly be a kettle. Hole dug into soil, 2 feet to bedrock. See Figure 1.

A_3- Sub-rounded, moderately weathered, pebbles (1 to 4 inches in diameter) of limestone, gabbro, granite and gneiss on top of the knob and along the sides of the knob near the top. These erratics were from 6 to 18 inches beneath the surface in the soil.

HILL 7, E $\frac{1}{2}$, SW $\frac{1}{4}$, T14N, R19W, Amanda Quadrangle

Knob is 120 feet high above the surrounding till plain. A sandy soil, much like on Snob's Knob (Figure 3), is on the top of the knob. Unlike Snob's Knob, however, erratics are present in the soil.

T- Rounded, slightly weathered pebble (2 inches in diameter) of gabbro , 3 inches in the soil.

HILL 8, SW $\frac{1}{4}$, SW $\frac{1}{4}$, Sec. 16, T14N, R19W, and SE $\frac{1}{4}$, SE $\frac{1}{4}$, Sec. 17, T14N, R19W, Amanda Quadrangle

West side of knob has a road cut in it. Observations were made in this cut on both sides of the road and 20 feet above the road at point D. Soil is clayey and developed on till and/or loess. Exposure reveals 3 feet of soil above bedrock sandstone as in Figure 2. Randomly distributed

boulders (0.5 to 1 foot in diameter) of sandstone lie on the surface with no source.

D- Angular to rounded, moderately weathered pebbles and cobbles (0.5 to 3 inches in diameter) of quartzite, chert, quartz monzonite, gneiss, shale, limestone, granite, and schist were taken from 0.5 to 3 feet depth in the soil.

HILL 9, SNOB'S KNOB (named by owner), S ½, Sec. 17, T14N, R19W, Amanda Quadrangle

Knob is 140 feet high above the surrounding till plain, with steep sides. The crest is essentially flat with isolated boulders of sandstone (0.5 feet in diameter) on the surface. Holes were dug into the soil, but no erratics discovered.

E_1, E_2, and E_3- These holes revealed a soil profile as in Figure 3. In all cases, the soil contained no erratics, and appeared to be developed on sandstone.

HILL 10, SW ¼, SW ¼, T13N, R20W, Amanda Quadrangle

Knob is only 40 feet above the surrounding till plain, with gentle slopes. The soil is sandy as on Snob's Knob and appears to be developed on sandstone.

Q- Angular, slightly weathered pebble of granite (1 inch in diameter) on the surface of the soil.

HILL 11, E ½, NW ¼, Sec. 19, T14N, R19W, Amanda Quadrangle

Knob is 120 feet high above the surrounding till

plain, with gently sloping sides. A quarry at the top of the knob is cut into the sandstone and a pond now occupys the quarry area. The soil is much like that of Hill 8, and is developed on glacial till and/or loess. A large erratic boulder approximately 3 feet in diameter, of igneous or metamorphic composition is in the center of the pond.

G_1- Well rounded, moderately weathered boulder (1.5 feet in diameter) of gneiss on surface near the crest of the knob.

G_2- Rounded, slightly weathered boulder (4 inches in diameter) of gneiss lying on the surface near the crest of the knob.

G_3- Angular to rounded, slightly to moderately weathered pebbles, cobbles, and boulders of erratics in great abundance at the crest of the knob. Samples of limestone, shale, granite, chert, fossiliferous limestone, gneiss, marble, quartzite, schist and gabbro were lying on the surface and a few inches below in the soil.

HILL 12, N $\frac{1}{2}$, NW $\frac{1}{4}$, Sec. 30, T14N, R19W, Amanda Quadrangle

Knob is 100 feet high above the surrounding till plain. The soil on top of the knob is clayey and much like that of Hill 8, and is developed on till and/or loess.

H_1- Rounded, moderately weathered boulder (8 inches in diameter) of granite was lying at the crest of the knob on the surface.

H_2- Rounded, moderately weathered pebbles and boulders (0.5 to 4 inches in diameter) of granite, gneiss,

and quartzite were excavated near the top of the knob.

H_3- About halfway up the slope, a large isolated boulder (2 feet in diameter) of schist was lying on the surface. The boulder may have been transported a short distance downhill from the crest of the knob by creep or by man.

HILLS 13, NW ¼, Sec. 24, T13N, R20W, Amanda Quadrangle

These knobs average 100 feet high above the surrounding till plain. The tops of the knobs are rounded, with a soil much as on Hill 10 and Snob's Knob.

R_1- Rounded, moderately weathered pebble of tillite 2 inches beneath the surface of the soil.

R_2- Sub-angular, moderately weathered pebble of gneiss, 1 inch within the soil.

HILL 14, SAND HILL, W ½, SW ¼, Sec. 23, T13N, R20W, Amanda Quadrangle

Knob is 145 feet high above surrounding till plain, with steep sides. The crest is essentially flat with isolated boulders of sandstone (0.5 to 4 feet in diameter) lying at random on the surface. The soil is clayey and much like that on Hill 8, and contains numerous erratics. The soil is developed on till and/or loess.

F_1- Angular to rounded, moderately weathered to slightly weathered pebbles of granite, gneiss, and chert (1 to 4 inches in diameter) were taken from 4 to 6 inches in depth in the soil.

F_2- Angular, slightly weathered pebbles of chert and granite

(1 to 2 inches in diameter) were 2 inches to 1 foot in the soil.

HILL 15, NW ¼, NW ¼, Sec. 31, T14N, R19W, Amanda Quadrangle

Knob is 90 feet high above the surrounding till plain, with steep sides. The top of the knob is flat and has a sandy soil developed on sandstone.

S- Sub-rounded, moderately weathered pebbles of granite and quartzite in 2 inches of soil.

HILL 17, SE ¼, NE ¼, Sec. 32, T14N, R19W, Amanda Quadrangle

Knob is 100 feet high above surrounding till plain. The soil on top of the knob is clayey and much like on Allen Knob.

M- Pebbles of granite, gneiss and quartzite, rounded, moderately weathered, and 1 to 3 inches in diameter, were 2 to 12 inches deep in the soil at the top of the knob.

HILLS 16, KNOBS SOUTH OF PLEASANT VALLEY, E ½, Sec. 31, T14N, R19W, Amanda Quadrangle

These knobs average 80 feet above the surrounding till plain. The soil on them is sandy, much like on Snob's Knob, with very few erratics.

N_1- A large rounded, moderately weathered boulder (2.5 feet in diameter) of gneiss had been excavated by the owner when he dug a foundation for his house trailer. The boulder was approximately 2 feet deep in the soil,

halfway down the slope from the crest of the knob.

N_2- Rounded, well weathered pebble of schist 2 inches within the soil.

N_3- Rounded, moderately weathered pebble of tillite taken from 3 inches depth in the soil at the top of the knob.

CONCLUSIONS

All of the bedrock knobs in the Amanda Quadrangle, Ohio, north of the glacial boundary and marked "U" on the Glacial Map of Fairfield County, Ohio (Forsyth, 1962), have evidence of glacial drift with the exception of only one hill which is within Illinoian glaciation.

In a description of a modern continental glacier, the Greenland Ice Sheet, Flint (1957) estimates the slope of the ice sheet near its center as well as at its margin.

> "The slopes of the broad interior region are gentle (between 1:100 and 1:2,000) but near the margin, slopes increase to as much as 1:5."

With a slope of only 1:100, the ice should have been much higher than these knobs, at least from 90 to 300 feet higher.

Many of the knobs have flat tops; this may be due to shearing or planing off of the sandstone by the glacier parallel to bedding. The fact that the tops are flat decreases the chances of post-glacial erosion of drift or loess from the tops of these hills, in constrast with the steeper sides of the knobs. On many of the knobs, however, forest cover has been removed by

man. For these knobs, at least, erosion would have had a better chance to remove much of the drift.

The presence of clayey soil on most of the knobs may be attributed to ice-deposited till, wind-deposited silt, or both, which has now deeply weathered to become the soil now present. It is possible that till was first deposited and subsequently covered by wind-blown silt. The numerous erratics that occur on the tops of these knobs could only have been transported there by glacier ice. In some cases the ice carried boulders 2 to 3 feet in diameter to the crests of the knobs. The ice moved not only erratics of igneous and metamorphic composition but also locally derived sandstone blocks and boulders, which may be found lying loose on the surface. Most of the erratics were buried in the soil, and may have been incorporated within the original till or covered by wind-blown silt soon after the retreat of the ice. This silt along with the till later weathered to a clayey soil.

The only knob studied which lacked evidence of glacial drift is Snob's Knob, Hill 9. This hill is just south of the Wisconsin Boundary (See Plate I). This may be explained by erosion of all evidence of glaciation since the retreat of the Illinoian ice sheet. The amount of time available for erosion to affect this hill since Illinoian glaciation is much greater than for the

other bedrock knobs.

The scope of this paper does not provide for detailed analysis of the soils on these knobs, nor does it attempt to identify the drift as to the type of moraine it represents. More study needs to be done on this matter. The failure of past workers to uncover evidence of glaciation on these knobs, especially the erratics, may (or may not) be due to the lack of realization that evidence of glacial drift may be covered by clayey soil which once was a wind-blown silt.

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FIGURE 1

ALLEN KNOB

HILL 6

SOIL PROFILE

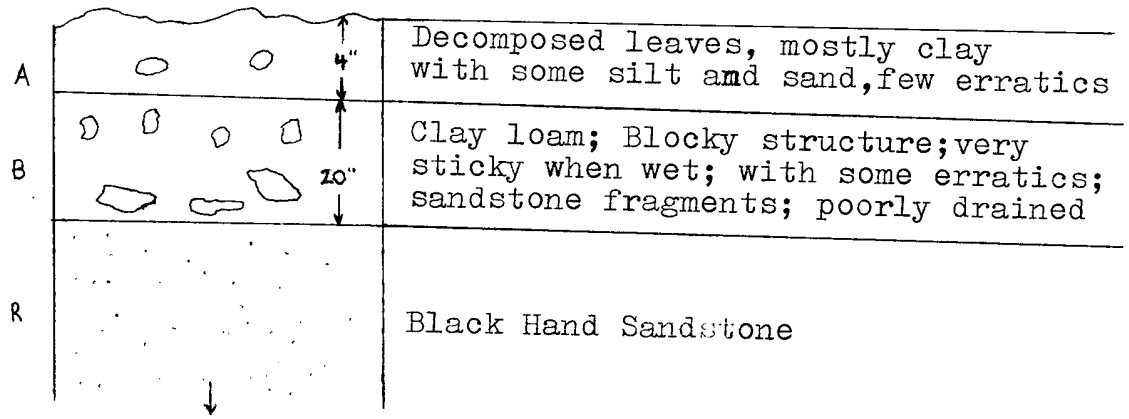


FIGURE 2

HILL 8

SOIL PROFILE

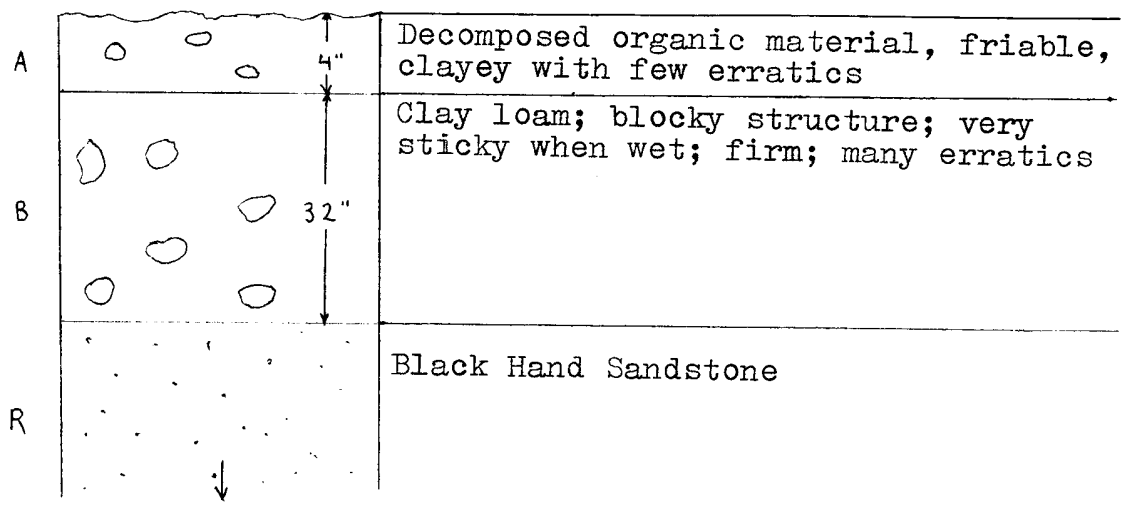


FIGURE 3

SNOB'S KNOB

HILL 9

SOIL PROFILE

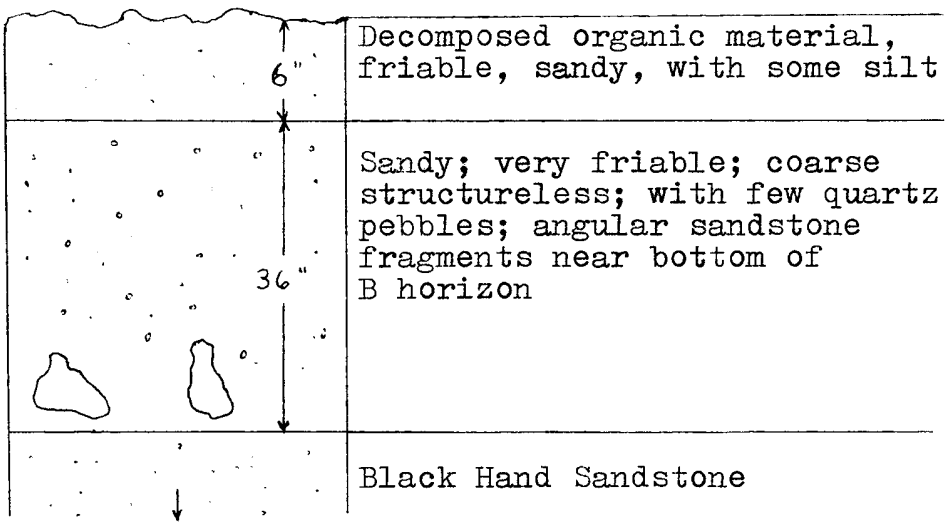
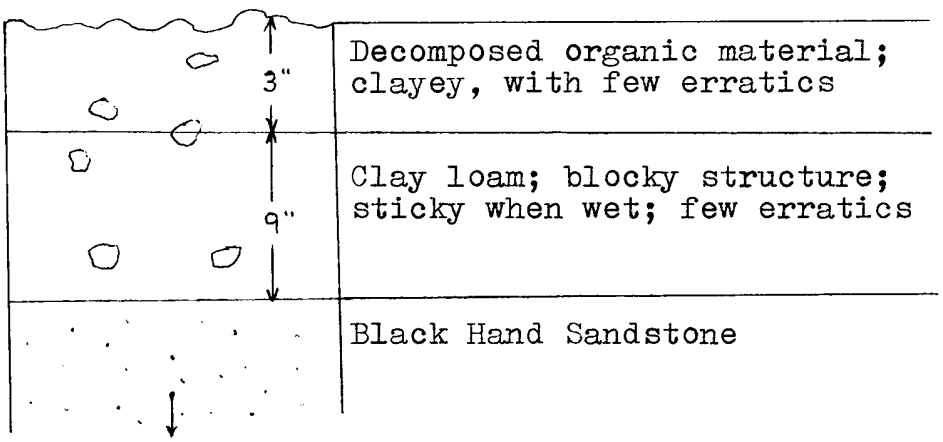


FIGURE 4

HILLS 3

SOIL PROFILE



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